THE VEGETATION AND FLORA OF THE MARIN ISLANDS, CALIFORNIA

ROBERT ORNDUFF
Department of Integrative Biology, University of California, Berkeley, CA 94720-3140

MICHAEL C. VASEY
Department of Biology, San Francisco State University, San Francisco, CA 94132

ABSTRACT

The Marin Islands in San Francisco Bay are two very small islands a short distance off the shore of San Rafael, Marin County, California. The vegetation and floras of the two islands are strikingly different. The herbaceous flora of the plateau on West Marin Island is dominated by a dense sward of the introduced annual grasses *Bromus diandrus* and *Avena fatua,* whereas the flora of the plateau on East Marin Island is dominated by a mixture of smaller, introduced grass species growing with several perennial and annual native forbs and grasses. Snowy Egrets, Great Egrets, Black-crowned Night Herons, Great Blue Herons, Western Gulls, and Canada Geese nest on West Marin Island; of these, only Canada Geese nest sparingly on East Marin Island. We attribute the floristic and vegetational differences between these islands to alterations of soil chemistry by bird guano and physical disturbances of the vegetation caused by the birds on West Marin Island, factors that are largely missing from East Marin Island, which was, until very recently, inhabited. The vegetation of both islands includes mixed evergreen forest, coastal prairie, coastal salt marsh, and northern coastal scrub. Several species of introduced ornamental trees, shrubs, and herbs grow on East Marin Island but not on West Marin Island. Both islands support a partially fringing woodland of *Quercus agrifolia, Aesculus californica,* and *Umbellularia californica.* The native *Sanicula crassicaulis, Stachys ajugoides* var. *rigida, Dryopteris arguta, Lonicera hispidula* var. *vacillans,* and *Symphoricarpus albus* var. *laevigatus* were frequent on East Marin Island but were not observed on West Marin Island; *Claytonia perfoliata* and *Polypodium californicum* were abundant on the former island but were sparingly represented on the latter one. The known native vascular flora of the two islands consists of 65 species; 26 of these occur on both islands, 37 are known only from East Marin Island, and two were collected only on West Marin Island.

The Marin Islands occur in San Rafael Bay, an arm of San Francisco Bay, approximately midway between Point San Pedro and Point San Quentin, Marin County, and ca. 0.8 km south of the nearest mainland point at San Rafael. West Marin Island is more or less ovate in outline, ca. 0.2 km long, and ca. 1.1 ha in area; East Marin Island is roughly L-shaped, ca. 0.4 km long, and ca. 4.2 ha in area. The two islands are separated from each other by ca. 170 m of water. All sides of each island are marked by steep cliffs, but the tops of the islands are more or less flat; the maximum elevation

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of the islands is ca. 20 m. In 1992, these islands came under the management of the U.S. Fish and Wildlife Service as The Marin Islands National Wildlife Refuge and State Ecological Preserve (Greene 1993). West Marin Island is a very important breeding site for Snowy Egrets, Great Egrets, Black-crowned Night Herons, and Great Blue Herons, all of which nest in the trees, and Western Gulls and Canada Geese, which nest on the ground. However, possibly because of prolonged human occupancy of East Marin Island, in 1993 the only birds of the foregoing group we observed nesting on East Marin Island were a few pairs of Canada Geese.

We were invited to undertake a floristic survey of the native plants of the Marin Islands by Richard Spight, a prime mover in negotiating their transfer from private to public ownership. The senior author or both authors visited these islands to observe and collect plants in October, 1991, and on 23 January and 16 March, 1992. The senior author made additional collections on East Marin Island on 2 June 1993. Because access to both islands was limited by the tides, we took only diagnostic fragments of the plants present and did not prepare voucher specimens. The only other botanical survey of the islands of which we are aware is that of Kroll (1991) who described the native and introduced vegetation of East Marin Island.

The natural vegetation of the Marin Islands consists of mixed evergreen forest, coastal prairie, coastal salt marsh, and northern coastal scrub (as recognized by Munz and Keck in Munz 1973). Howell (1970) circumscribed plant communities in Marin County somewhat differently; in his scheme, the natural vegetation of the Marin Islands consists of oak-buckeye forest (seven of the ten "more common" woody species he listed for this community grow together on East Marin Island), coastal brush, hill and valley grassland, and salt marsh. A recent account of Marin County plant communities (Shuford and Timossi 1989) mostly utilized the community names of Munz and Keck, but recognized associations within these. According to these authors, the forest association on the Marin Islands is oak-bay-madrone (but with madrone missing) and the scrub association is coastal sage-coyote brush scrub. Coastal prairie and coastal salt marsh were also recognized by these authors. Because the vegetation and flora of the two islands are different, these features will be described separately for each island.

East Marin Island

The plateau region of East Marin Island is dominated by several species of introduced trees, the most common of which is *Pinus radiata*. Several of the non-native plant species on the island were introduced as ornamentals, and some of these have become naturalized on the island. In addition, a number of introduced "weeds"

are also present on the island, probably as a result of accidental introductions. Elizabeth McClintock, who joined us on some of our visits, has recorded 46 introduced species of angiosperms on this island (McClintock personal communication).

A small herd of Barbary sheep (*Ammotragus lervia*) was introduced to this island in the 1980's to reduce vegetative cover and hence fire risk; in 1991, the sheep were removed. Their impact on the flora is unknown. In 1992, a resident caretaker left the island, leaving it uninhabited.

The natural forest on East Marin Island consists of *Quercus agrifolia, Aesculus californica,* and *Umbellularia californica.* These trees are common and occur mostly on the sheltered, moister northern side of the island. The understory consists of a few shrub species such as *Toxicodendron diversilobum* (which, however, occurs elsewhere on the island), *Symphoricarpos albus* var. *laevigatus, Holodiscus discolor, Rosa gymnocarpa,* and *Sambucus mexicana.* A common shrub along the edge of this forest is *Heteromeles arbutifolia,* which occurs elsewhere on the island as well. *Lonicera hispidula* var. *vacillans* is a common woody vine climbing in the trees. The herbaceous understory includes three ferns: *Dryopteris arguta* and *Polypodium californicum,* both of which are common, and *Adiantum jordanii,* which is uncommon. Of the native herbaceous angiosperms, only *Scrophularia californica* appears to be limited to this forest community. Other herbaceous species may occur both in this community and elsewhere on the island.

Northern coastal scrub is well developed on East Marin Island, occurring at the tops and faces of the cliffs along the western, southern, and eastern portions of the island. *Artemisia californica, Eriophyllum staechadifolium,* and *Mimulus aurantiacus* are common components of this community. We noted only a single individual of *Baccharis pilularis* on the island in 1991–1993. During that time there were numerous, apparently drought-killed shrubs in the scrub on this island, which appeared to be mostly if not exclusively introduced brooms (*Cytisus* or *Genista* spp.).

Despite the density of several introduced trees on East Marin Island, notably concentrated on the plateau, the prairie community that presumably predates the introduction of these trees still persists, although the species richness may have decreased due to shading and competition from the exotics. The native perennial grass *Nassella lepida* is abundant on the plateau. Common native forbs that occur with this grass include *Chlorogalum pomeridianum, Sanicula crassicaulis,* and *Stachys ajugoides* var. *rigida.* Other forbs that occur in the grassland, but elsewhere on the island as well, are *Eschscholzia californica* and *Claytonia perfoliata,* both of which are common, and scattered plants of *Gnaphalium stramineum* and *Achillea millefolium. Carex barbarae* forms large, conspicuous swards in a few places.

Dichondra donelliana occurs locally on the eastern end of the island, but may have been introduced to the site. Kroll (1991) believed that the *Rubus* on the island is native, but we consider it to be the introduced *R. discolor* Weihe & Nees as does McClintock (personal communication).

A small pond of artificial origin occurs at the base of a quarried cliff on the south side of East Marin Island. The pond margin is occupied by a very depauperate coastal salt marsh, with *Distichlis spicata,* also noted as scattered individuals on the rocky south shore, *Jaumea carnosa,* and *Salicornia virginica* present. The aquatic green alga *Cladophora* sp. and *Ruppia maritima* are present in this pond.

Several plant species, many of which are common on the island, do not occur in well-defined, generally recognized plant communities. For example, *Dudleya cymosa* ssp. *paniculata, Eriogonum nudum, Lotus scoparius,* and *Spergularia macrotheca* mostly occur as scattered individuals on the cliff faces, particularly on the south side of the island. The annual *Phacelia distans* forms several large localized colonies near the base of the southern cliff, and the perennial *Stephanomeria elata* was represented by only a few plants growing on rocky slopes at the extreme eastern end of the island. A few scattered individuals of an unidentified *Arbutus* occur on the plateau, but their distribution, short stature, and much-branched condition suggest that these were planted and are not the native *A. menziesii.*

Numerous lichens are present on the soil, rocks, and especially on the trees. These include *Flavopunctelia flaventior, Physcia callosa, Punctelia subrudecta, Rinodina* sp., and *Xanthoria polycarpa.* Terrestrial and epiphytic bryophytes are also common but were not identified.

West Marin Island

The forest on West Marin Island is depauperate compared with that on East Marin Island. On the western portions of this island, *Quercus agrifolia* and *Heteromeles arbutifolia* occur as shrubs interspersed with *Rosa gymnocarpa* in a matrix of annual introduced grasses. The eastern portion is dominated by larger individuals of the oak and *H. arbutifolia,* but also includes *Sambucus mexicana.* Several of the trees in this eastern area are infested by *Hedera helix.* The central and northern slopes of the island support the best developed forest, where the dominant tree is *Aesculus californica.* Several large, spreading buckeyes of obvious antiquity occupy this area. They are the favored nesting sites for the Black-crowned Night Heron (*Nycticorax nycticorax*), Snowy Egret (*Egretta thula*), Great Egret (*Casmerodius albus*), and Great Blue Heron (*Ardea herodias*). Their major branches are cloaked with twiggy nest platforms. Some individuals of *Quercus agrifolia* occur in this area as well but they are

dwarfed by the buckeyes. The understory directly beneath the buckeyes is essentially bare, perhaps due to the influence of the nesting birds. In these areas, nests of the Canada Goose (*Branta canadensis*) are found. We did not observe nesting of the Western Gull (*Larus occidentalis*), but it apparently nests on relatively open sites.

Northern coastal scrub on West Marin Island occurs in two distinct phases. The southern and eastern margin of the island is dominated by *Artemisia californica* with very few shrubs of *Mimulus aurantiacus.* The cliffs in this area also host *Dudleya cymosa, Eriogonum nudum,* and the introduced *Sonchus oleraceus.* In contrast, northern coastal scrub elements along the western and northern margins of the island include *Baccharis pilularis* and *Eriophyllum staechadifolum.* Northside cliffs also host *Scrophularia californica* and *Polypodium californicum.*

Coastal salt marsh elements occur sporadically in the zone where the cliffs meet the cobble beach that fringes the island. For example, a small patch of *Frankenia salina* occurs at the eastern tip of the island. *Spergularia macrotheca* is found in cliff crevices near the water line on the northern margin of the island. *Salicornia virginica* occurs more generally in this habitat.

Comparison of the Two Islands

There are notable vegetational and floristic differences between West Marin and East Marin islands. The plateau on West Marin Island is dominated in winter and spring by a very dense sward of introduced annual grasses. On the northern side of the plateau and the slopes below it *Bromus diandrus* predominates and on the southern side of the plateau and the slopes below it *Avena fatua* predominates. These grasses dominate most areas where soil has formed on the plateau and down the cliff sides. While these grasses are not normally considered nitrophiles, they thrive on the guano-enriched soils to the exclusion of most other introduced and native vascular plants. Recruitment of the major tree and shrub species appears to be virtually nil on this island. Both grasses also occur on East Marin Island, but only on the extreme eastern tip of that island, where birds (apparently mostly Canada Geese) congregate but do not nest, do they form the dense stands seen on West Marin Island.

The soil under the trees in which the birds roost and nest on West Marin Island is bare, probably due to a combination of shading and extreme guano enrichment. Anderson (1960) attributed these bare areas to guano deposits. There are also occasional bare areas in the grasslands that appear to be induced by the physical presence of (but not the nesting of) birds. In places, grasses had been uprooted by birds, perhaps during the course of courtship, territorial displays, or nest-building. The bare soil under *Aesculus californica* was littered

with green branch tips during a visit in mid-March. These appear to have been clipped by the Black-crowned Night Herons and Great Egrets that were beginning to nest. The long-term effect of this pruning on the growth pattern of the trees is uncertain.

Three herbaceous species that are extremely abundant on East Marin Island appear to be absent from West Marin Island: *Sanicula crassicaulis, Stachys ajugoides* var. *rigida,* and *Dryopteris arguta. Claytonia perfoliata* and *Polypodium californicum,* both common on East Marin Island, are sparingly represented on West Marin Island. The woody *Lonicera hispidula* var. *vacillans* and *Symphoricarpos albus* var. *laevigatus,* both common on East Marin Island, appear to be missing from West Marin Island. In contrast, *Scrophularia californica* competes very well with the introduced annual grasses and is probably more abundant per unit area on West Marin Island than on East Marin Island.

We were struck by these striking vegetational and floristic differences between the two islands, differences that we belive are due to the prolonged presence of large numbers of birds on West Marin Island but not on East Marin Island. As described above, these birds apparently have important effects on plant life by the physical disturbances they cause and, more important, by alterations of soil chemistry due to deposition of guano. Striking effects of seabird occupancy on the vegetation and flora of oceanic islands have been noted (Ornduff 1965; references in Vasey 1990). With the exception of the few primarily floristic studies of the Farallon Islands (Ornduff 1961; Coulter 1971, 1978; Vasey 1990), the vegetation and flora of the coastal islands of California harboring extensive seabird rookeries appear to be unstudied. Since humans no longer reside on East Marin Island and human visitation to both Marin islands is now highly restricted, we suspect that soon most if not all the bird species that nest on West Marin Island will begin to nest on East Marin Island. If this happens, and our surmise about the impact of these birds on the plant life of West Marin Island is correct, vegetational and floristic patterns on East Marin Island will begin to change. Although our studies are not quantitative, we hope our observations on the present vegetation and flora of both islands will provide a stimulus for others to conduct quantitative investigations in the near future and to monitor possible biotic changes on East Marin Island in the next few decades.

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Native Vascular Plants of the Marin Islands

The known native vascular flora of the two islands consists of 65 species. Twenty-six of these are known from both islands, 37 are known only from East Marin Island, and two were collected only on West Marin Island. Doubtless we overlooked several native and introduced species during our visits. The nomenclature in the appended list follows that used in The Jepson Manual: higher plants of California (Hickman 1993). (W = recorded on West Marin Island, E = recorded on East Marin Island):

Flowering Plants

Achillea millefolium L. (Asteraceae) E
Aesculus californica (Spach) Nutt. (Hippocastanaceae) W, E
Amsinckia sp. (Boraginaceae) E
Artemisia californica Less. (Asteraceae) W, E
Artemisia douglasiana Besser (Asteraceae) E
Baccharis pilularis DC. (Asteraceae) W, E
Brodiaea californica Lindl. var. *californica* (Liliaceae) E
Calystegia purpurata (E. Greene) Brummitt ssp. *purpurata* (Convolvulaceae) E
Camissonia ovata (Torr. & A. Gray) Raven (Onagraceae) E
Carex barbarae Dewey (Cyperaceae) E
Chlorogalum pomeridianum (DC.) Kunth var. *pomeridianum* (Liliaceae) W, E
Clarkia rubicunda (Lindl.) H. Lewis & M. Lewis (Onagraceae) W
Claytonia perfoliata Willd. ssp. *perfoliata* (Portulacaceae) W, E
Cressa truxillensis Kunth (Convolvulaceae) E
Cynoglossum grande Lehm. (Boraginaceae) E
Dichelostemma capitatum Alph. Wood ssp. *capitatum* (Liliaceae) E
Dichondra donelliana Tharp & M. Johnston (Convolvulaceae) E
Distichlis spicata (L.) E. Greene (Poaceae) W, E

Dudleya cymosa (Lemaire) Britton & Rose ssp. *paniculata* (Jeps.) K. Nakai (Crassulaceae) W, E
Eriogonum nudum Benth. var. *nudum* (Polygonaceae) W, E
Eriophyllum staechadifolium Lagasca (Asteraceae) W, E
Eschscholzia californica Cham. (Papaveraceae) W, E
Festuca californica Vasey (Poaceae) W
Frankenia salina (Molina) I.M. Johnston (Frankeniaceae) W, E
Gnaphalium canescens DC. (Asteraceae) E
Gnaphalium stramineum Kunth (Asteraceae) E
Heteromeles arbutifolia (Lindley) Roem. (Rosaceae) W, E
Holodiscus discolor (Pursh) Maxim. (Rosaceae) W, E
Iris sp. (Iridaceae) E
Jaumea carnosa (Less.) A. Gray (Asteraceae) E
Lathyrus sp. (Fabaceae) W, E
Lomatium utriculatum (Torr. & Gray) J. Coult. & Rose? (Apiaceae) E
Lonicera hispidula Douglas var. *vacillans* A. Gray (Caprifoliaceae) E
Lotus scoparius (Nutt.) Ottley var. *scoparius* (Fabaceae) W, E
Lupinus nanus Benth. (Fabaceae) E
Luzula comosa E. Meyer (Juncaceae) E
Melica torreyana Scribner (Poaceae) E
Mimulus aurantiacus Curtis (Scrophulariaceae) W, E
Nassella lepida (A. Hitchc.) Barkworth (Poaceae) E
Nassella pulchra (A. Hitchc.) Barkworth (Poaceae) E
Triphysaria pusilla (Benth.) Chuang & Heckard (Scrophulariaceae) E
Phacelia distans Benth. (Hydrophyllaceae) E
Polycarpon depressum Nutt. (Caryophyllaceae) E
Quercus agrifolia Nee (Fagaceae) W, E
Rosa gymnocarpa Nutt. (Rosaceae) W, E
Rumex salicifolius J.A. Weinm. var. *crassus* (Rech.f.) J. Howell (Polygonaceae) E
Ruppia maritima L. (Potamogetonaceae) E
Salicornia virginica L. (Chenopodiaceae) W, E
Sambucus mexicana C. Presl (Caprifoliaceae) W, E
Sanicula crassicaulis DC. (Apiaceae) E
Scrophularia californica Cham. & Schlecht. ssp. *californica* (Scrophulariaceae) W, E
Spergularia macrotheca (Hornem.) Heynh. var. *macrotheca* (Caryophyllaceae) W, E
Stachys ajugoides Benth. var. *rigida* Jeps. & Hoover (Lamiaceae) E
Stephanomeria elata Nutt. (Asteraceae) E
Symphoricarpos albus (L.) S.F. Blake var. *laevigatus* (Fern.) S.F. Blake (Caprifoliaceae) E
Toxicodendron diversilobum (Torr. & A. Gray) E. Greene (Anacardiaceae) W, E
Umbellularia californica (Hook. & Arn.) Nutt. (Lauraceae) W, E
Vicia americana Willd. var. *americana* (Fabaceae) Vetch E
Viola pedunculata Torr. & A. Gray (Violaceae) E
Zigadenus fremontii (Torr.) S. Watson (Liliaceae) W, E

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Adiantum jordanii C. Mueller (Pteridaceae) E
Dryopteris arguta (Kaulf.) Maxon (Dryopteridaceae) E
Pentagramma triangularis (Kaulf.) G. Yatskievych, M.D. Windham & E. Wollenweber ssp. *triangularis* (Pteridaceae) E
Polypodium californicum Kaulf. (Polypodiaceae) W, E